Coastal Flood Management

Global Innovations

Tuesday, 13 December 2005

Global Innovative Flood Control Barriers

Protecting people, property and environment

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Topics

- Large European Flood Control Barriers
- Background
- Facts and figures
- Operational, under construction or in planning phase
- Concluding remarks

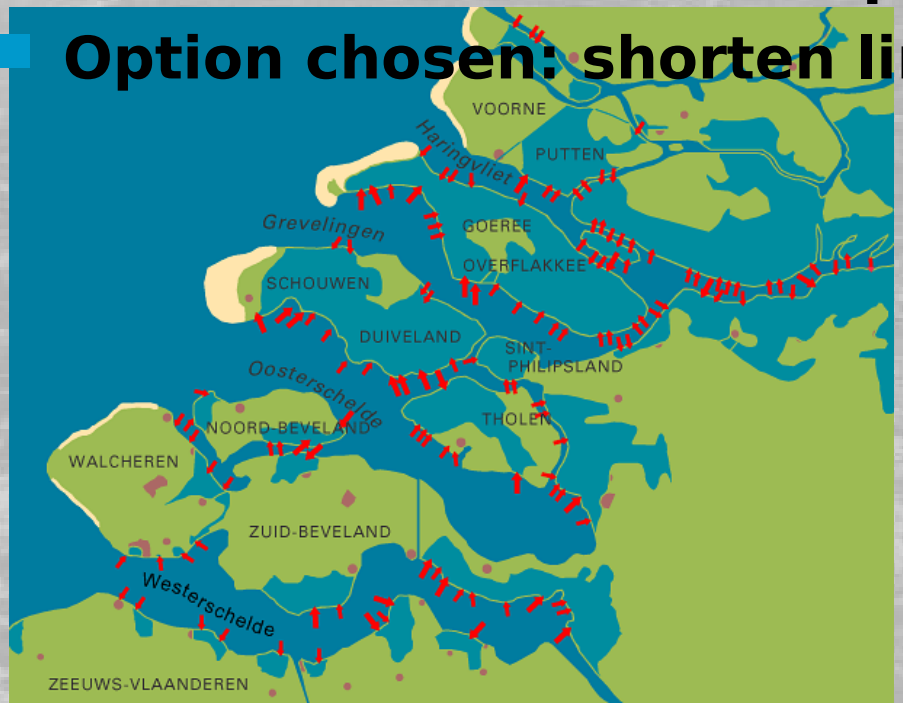
Flood Protection Barriers covered

- Eastern Scheldt Storm Surge Barrier, The Netherlands
- Maeslant Barrier, Rotterdam, The Netherlands
- Water Control Gates, Venice, Italy
- St. Petersburg Flood Protection Barrier, Russia
- Thames Barrier, London, United Kingdom

Sea Barrier Structures, The Netherlands

- Netherlands: below sea-level in Rhine and Meuse delta
- 1953: storm surge floods south-western part of the Netherlands
- Highly traumatic experience, main lessons: do not forget,

  but to be aware and be prepared
- Option chosen: shorten line of defence!



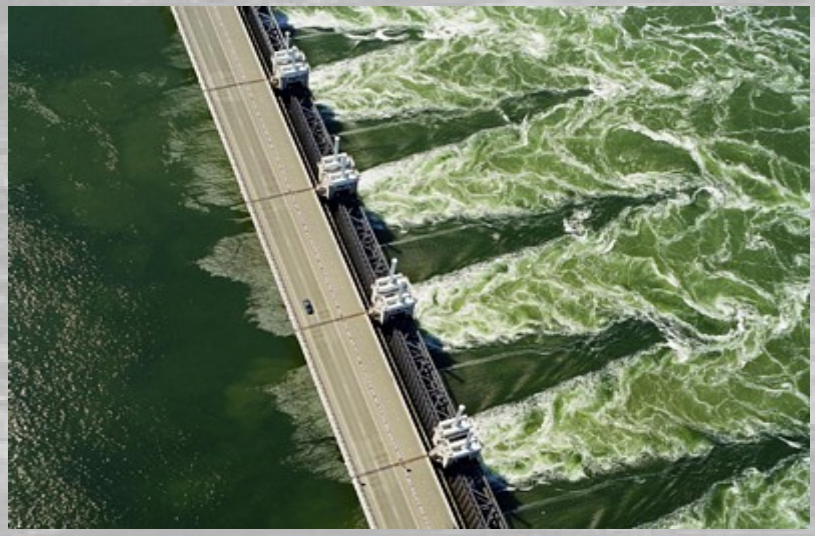
Eastern Scheldt Barrier, The Netherlands

- **1954: Full closure plan of Eastern Scheldt inlet, closed coastline to protect the southwestern part of Holland and Zeeland from flood threats**
- **1975: Pressure from fishing, oyster and mussel culture and increased environmental awareness, plans for closure changed**
- **1987: commissioning of the barrier**
- **Years ’90: extensive monitoring and evaluation**
- **Leading to changing views on functioning and purpose…**

Eastern Scheldt Barrier, The Netherlands

Facts and figures

- **Costs 8.7 billion $ US (price level 2005)**
- **Protection level, return period 1:4,000 years**
- **Protecting roughly 100,000 people and large nature area**
- **Completed 1986 / 1987**

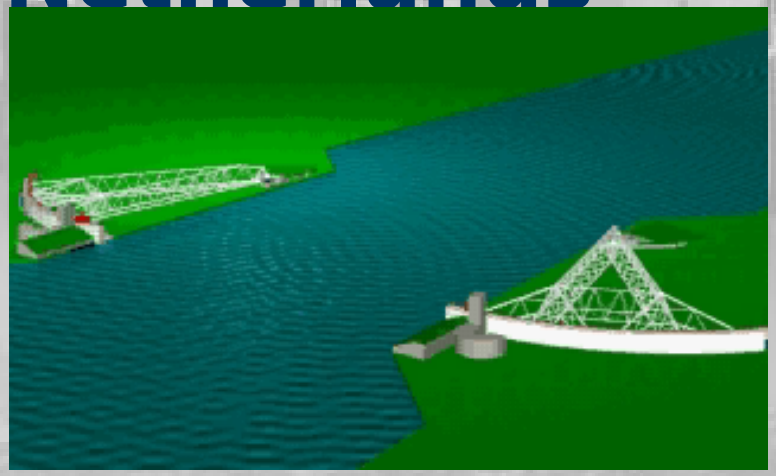


Maeslant Barrier, Rotterdam, The Netherlands

Facts and figures

- **Closing off (parts of) one of the largest ports in the world**
- **Intensive shipping traffic**
- **Costs: $530M**
- **Protecting 1 million people and one of the largest industrial areas in Europe**
- **Protection level 1:10,000**
- **Completed 1997**

Maeslant Barrier, Rotterdam, The Netherlands



- Design and construct contract
- Design criteria included
  - minimal protection against flooding
  - minimal depth of shipping route
  - minimal width of shipping route
  - closure time (traffic interrupted) less than 1%, or once in 5 to 10 years
  - no overhead constructions
- Design optimized using physical modeling techniques, reduction of vibration

Maeslant Barrier, Rotterdam, The Netherlands

- Ball joints designed to ensure movement of gates in all directions
- Ball joints transfer pressure of water on gates to foundation
- Three times bigger than ever used before!
- Operation of the barrier fully computerised, using Command and Support system

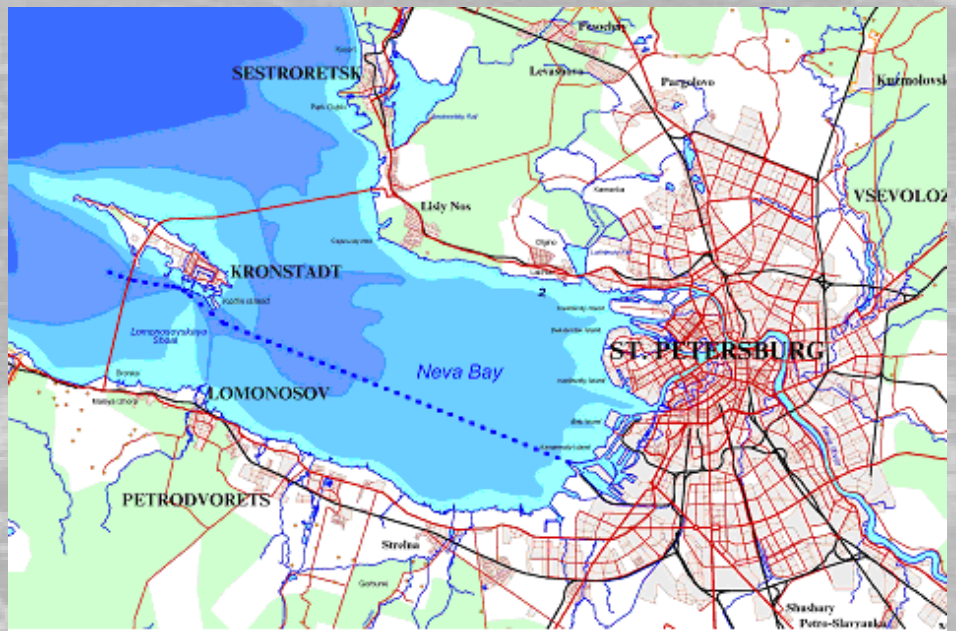
St. Petersburg Flood Protection Barrier, Russia

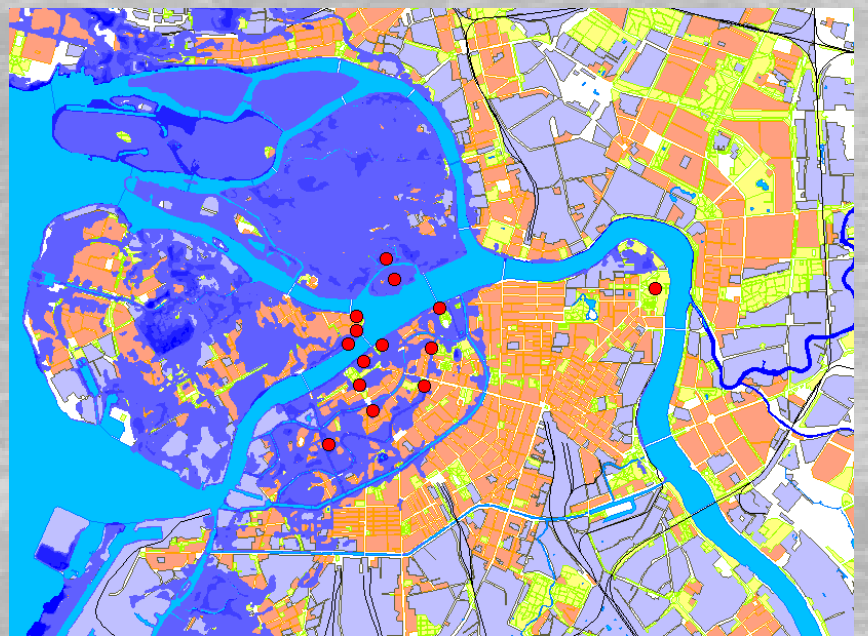
St. Petersburg

- **is situated just several feet above mean sea level in the Neva Delta**
- **has experienced many serious floodings throughout its history due to high water in the Gulf of Finland.**
- **with the present population a flood of 3m with a return period of 50 years could be catastrophic**

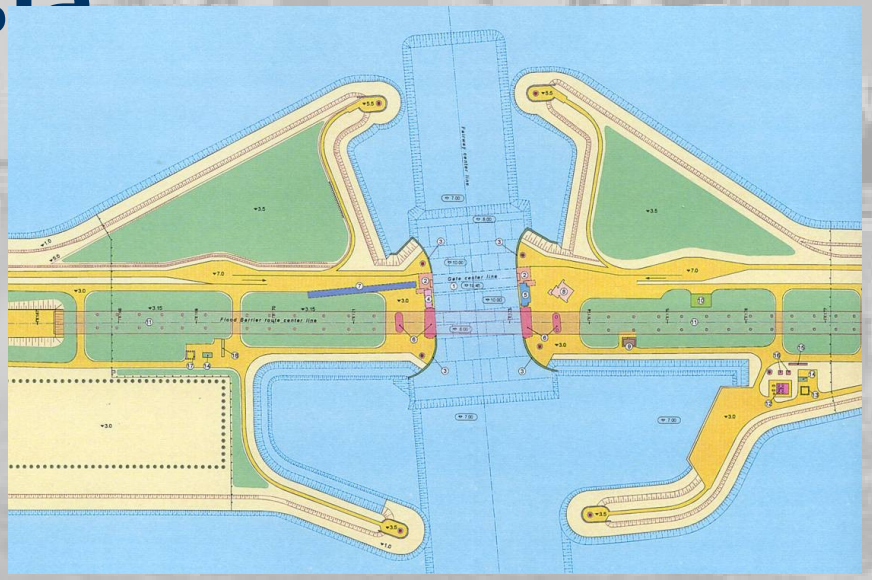
St. Petersburg Flood Protection Barrier, Russia

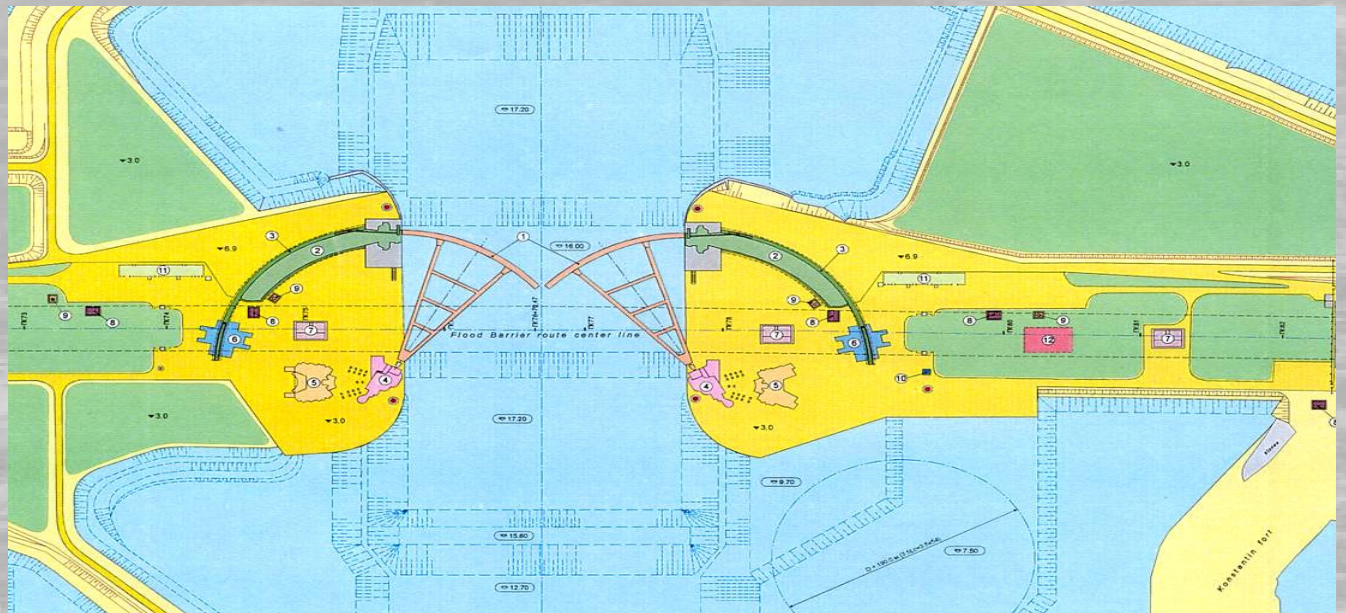
- 1980: Start of construction of Flood Protection barrier (FPB):
- 1987: Suspension of construction due due to a huge environmental controversy and a lack of funding.
- 1990 - 2000 changing political and financial situation
- 2001: Feasibility study of FPB completion financed by Dutch government
- 2002: Series of studies financed by EBRD (WL leads EIA, contributes to TFS)
- 2008: Planned completion of FPB





St. Petersburg Flood Protection Barrier, Russia





St. Petersburg Flood Protection Barrier, Russia

Facts and figures

- **length 23 kilometer, 6 movable flood gate complexes and 2 navigable openings**
- **protects 5 million people**
- **costs (for completion): $840 million (100% over budget)**
- **protection level, return period of 1:10,000**
- **to be completed in 2008**

Water Control Gates Venice, Italy

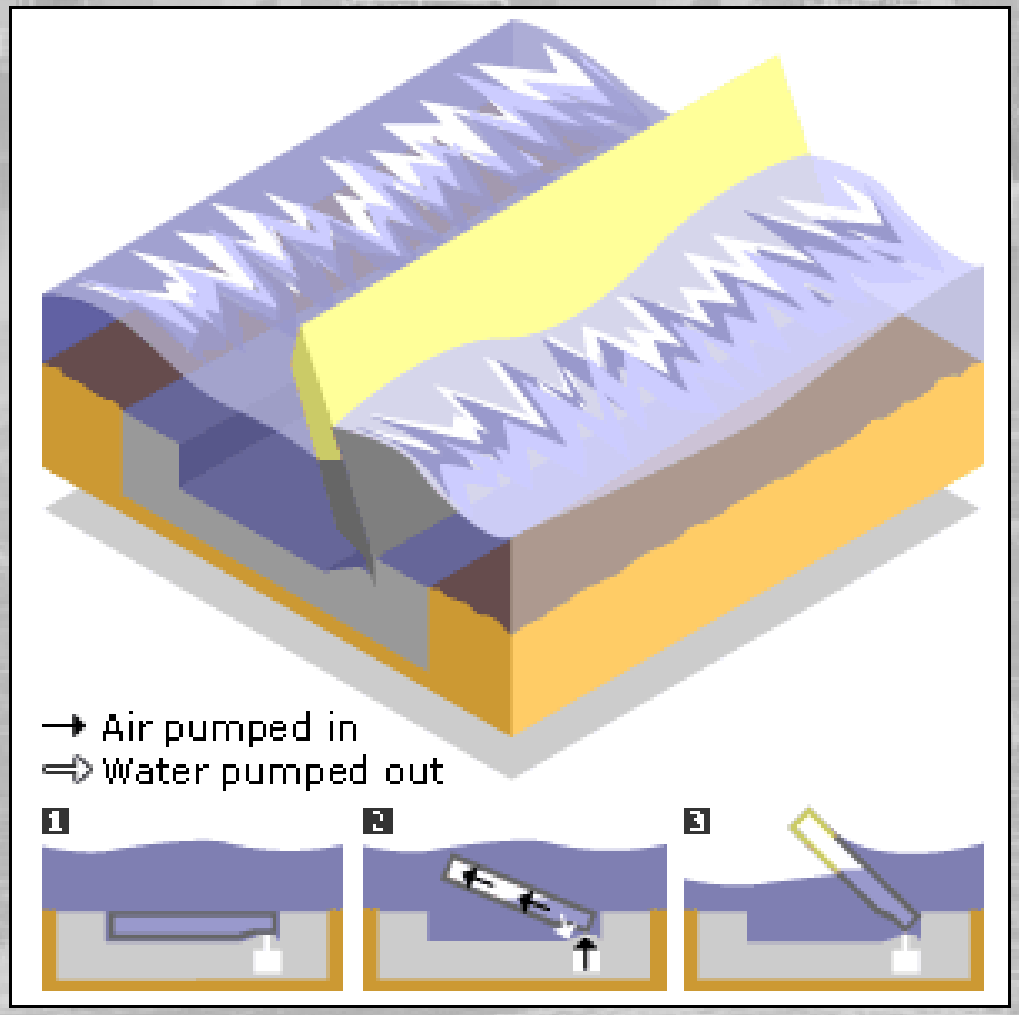
- situated in Venice Lagoon in Adriatic sea
- regular flooding is damaging the historic city
- Venice lagoon suffers from man-made interventions and pollution
- flooding risk increases due to sea level rise and soil subsidence

Water Control Gates Venice, Italy

Some facts and figures

- **mobile gates in the three inlets**
- **offshore breakwaters in front of the entrances**
- **costs: $5.30 billion ($2.7 billion was estimated in 2004)**

Water Control Gates Venice, Italy:



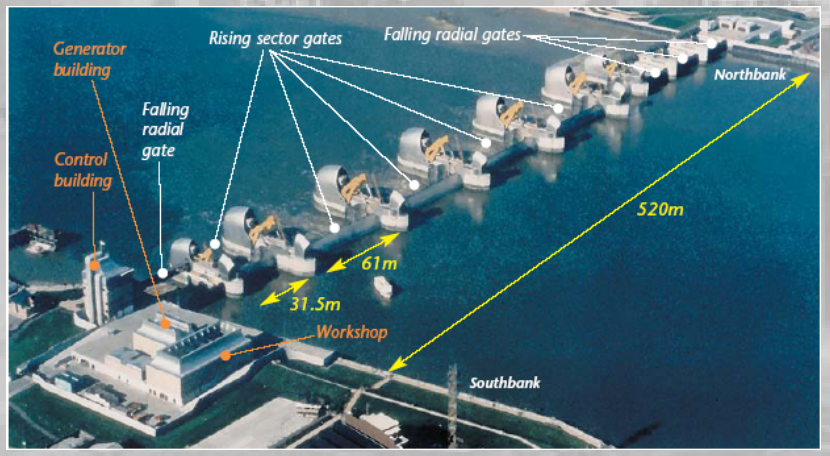
- 1. In normal conditions, the floodgates lie on the seabed
- 2. When high tides are expected, compressed air is pumped into the gates, causing the gates to rise
- 3. Once raised the gates form a slanting barrier against the incoming tide
- The gates are 30 metres high and five metres thick

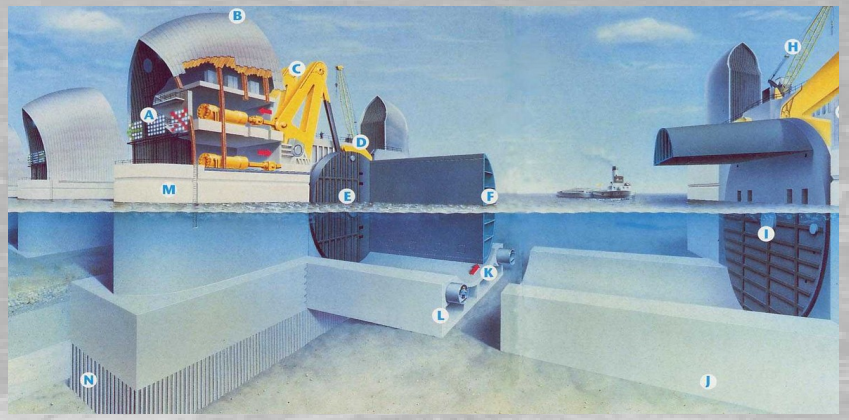
Water Control Gates Venice, Italy:

Dutch expertise used for:

- **Design of the movable barriers: nautical aspects and bed protection (scale models)**
- **Hydrodynamical, morphological and ecological modelling of the Venice lagoon (numerical models)**
- **Design of sluice complexes**
- **Study of the construction phases of the structures around the mobile gates**

Thames Barrier, London, United Kingdom



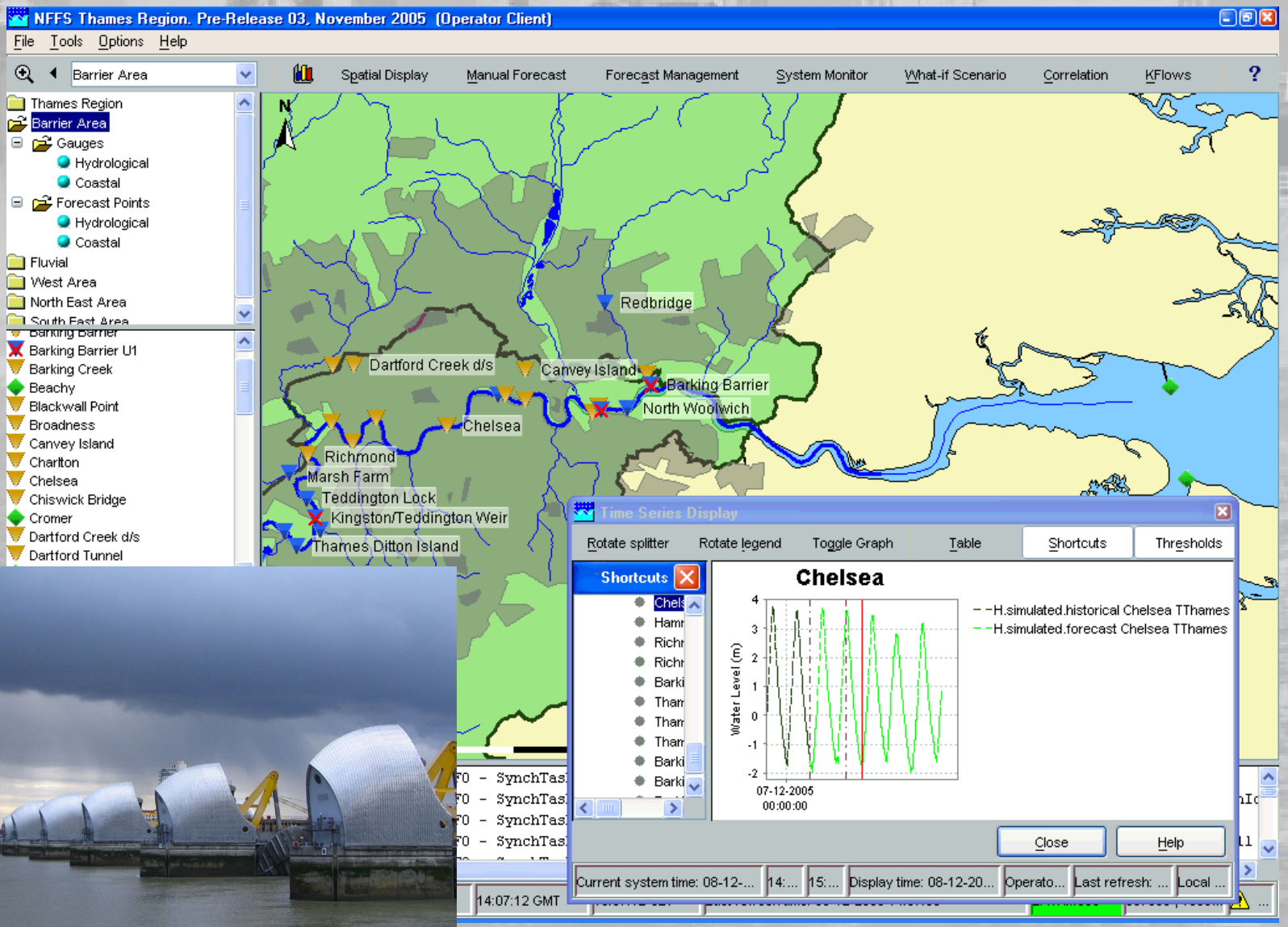


courtesy UK Env. Agency

Facts and figures

- **trigger: 1953 storm surge**
- **1.25 million people at risk**
- **estimated damage figure for the tidal flooding of London of $140 billion (today)**
- **protection level 1:2,000**
- **costs: $760 million (75% over budget, due to inflation in the 1970's)**
- **barrier completed in 1982**
- **closing 4 to 5 times / year**

Thames Barrier, UK



Concluding remarks

- Major investments in flood protection are largely event driven
- Planning and design of the large flood protection works presented here usually started from a flood protection perspective only, ensuring protection for people and property
- Environmental aspects gained interest during planning and construction phase, often under considerable public pressure
- Some effects of new infrastructure are predictable, others are less or not predictable
- Continued monitoring and maintenance are therefore essential parts of the project

Meeting of barrier management groups

- Operational aspects barrier management are discussed between responsible authorities
- First meeting earlier this year in St. Petersburg, representatives of all barrier management authorities attended
- Next meeting in Venice, July 2007